

CLAIMS

What is claimed is:

1. A method for reducing peeling of a cross-linked polymer passivation layer in a solder bump formation process comprising the steps of:

providing a multi-level semiconductor device formed on a semiconductor process wafer having an uppermost surface comprising a metal bonding pad in electrical communication with underlying device levels;

forming a layer of resinous pre-cursor polymeric material over the process surface said resinous polymeric material having a glass transition temperature (T_g) upon curing;

subjecting the semiconductor process wafer to a pre-curing thermal treatment temperature below T_g for a period of time; and,

subjecting the semiconductor process wafer to at least one subsequent thermal treatment temperature above T_g for a period of time to form an uppermost passivation layer.

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2. The method of claim 1, wherein the pre-curing thermal treatment temperature is within about 20 °C to about 60 °C of T_g.

3. The method of claim 1, wherein the subsequent thermal treatment temperature above T_g comprises a thermal curing treatment temperature of greater than about 40 °C above T_g.

4. The method of claim 3, wherein the pre-curing thermal treatment is carried out for a time period between about 1/5 and about 1/30 of the thermal curing treatment time period.

5. The method of claim 1, wherein the subsequent thermal treatment temperature above T_g comprises a second pre-curing thermal temperature of not greater than about 40 °C above T_g.

6. The method of claim 1, wherein T_g is between about 200 °C and about 300 °C.

7. The method of claim 1, wherein the resinous pre-cursor polymeric material comprises a polyimide.

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8. The method of claim 7, wherein T_g is between about 240 °C and about 300 °C.

9. The method of claim 7, wherein the pre-curing thermal treatment comprises a treatment temperature between about 180 °C and about 220 °C for a period of from about 3 minutes to about 10 minutes and the thermal curing treatment comprises a temperature of from about 320 °C to about 370 °C for a period of from about 90 minutes to about 180 minutes.

10. The method of claim 1, further comprising the steps of:

forming an opening in the uppermost passivation layer to expose the metal bonding pad;

forming at least one layer of under bump metallurgy (UBM) over the passivation layer and metal bonding pad in a solder bump formation process;

photolithographically patterning a photoresist layer formed over the UBM and etching the at least one layer of UBM to leave a UBM portion overlying the bonding pad; and,

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performing a wet stripping process to remove the photoresist layer the wet stripping process comprising at least one of an acidic and basic wet stripping solution.

11. The method of claim 10, wherein the photoresist comprises a dry film photoresist.

12. The method of claim 10, wherein the UBM comprises at least one of Ti, Cr, Al, Cu, CrCu, Ni, and NiV.

13. The method of claim 8, further comprising forming a solder ball over the UBM.

14. A method for reducing peeling of a polyimide polymer passivation layer in a solder bump formation process comprising the steps of:

providing a multi-level semiconductor device formed on a semiconductor process wafer having an uppermost surface comprising a metal bonding pad in electrical communication with underlying device levels;

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forming a layer of resinous pre-cursor polyimide material over the process surface said resinous polyimide material having a glass transition temperature (T_g) upon forming a cross-linked structure;

subjecting the semiconductor process wafer to at least one pre-curing thermal treatment comprising a treatment temperature below T_g for a period of time to initiate polymeric cross-linking reactions; and,

subjecting the semiconductor process wafer to a thermal curing treatment comprising a treatment temperature greater than about 40 °C above T_g for a period of time to form an uppermost passivation layer.

15. The method of claim 14, wherein the at least one pre-curing thermal treatment comprises a treatment temperature within about 20 °C to about 60 °C lower than T_g .

16. The method of claim 14, wherein the at least one pre-curing thermal treatment comprises a second treatment temperature within about 40 °C greater than T_g .

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17. The method of claim 14, wherein the at least one pre-curing thermal treatment is carried out for a time period between about 1/5 and about 1/30 of the thermal curing treatment.

18. The method of claim 14, wherein Tg is between about 240 °C and about 300 °C.

19. The method of claim 14, wherein the at least one pre-curing thermal treatment comprises a treatment temperature between about 180 °C and about 220 °C for a period of from about 3 minutes to about 10 minutes.

20. The method of claim 14, further comprising the steps of:

forming an opening in the uppermost passivation layer to expose the metal bonding pad;

forming at least one layer of under bump metallurgy (UBM) over the passivation layer and metal bonding pad in a solder bump formation process;

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photolithographically patterning a photoresist layer formed over the UBM and etching the at least one layer of UBM to leave a UBM portion overlying the bonding pad;

performing a wet stripping process to remove the photoresist layer the wet stripping process comprising at least one of an acidic and basic wet stripping solution; and,

forming a solder ball over the UBM.